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FERTILIZERS: MATERIAL SUPPLYING NITROGEN.

The fertilizer bill of North Carolina in 1903 was between \$6,000,000 and \$7,000,000.

Fertilizers are used for the sake of the nitrogen (or ammonia), phosphoric acid and potash they contain. These three are more often deficient in soils than the other constituents necessary to the growth of plants and are the ones soonest exhausted in cropping. Nitrogen, phosphoric acid and potash are not more necessary than the other constituents of plants, but with the exception of these, and of lime in some cases, there is an abundance of the mineral elements in all soils for the requirements of all crops.

Fertilizer materials and fertilizers, then, are bought and applied to the land because they contain these deficient or needed constituents and are valuable in proportion to their richness in nitrogen, phosphoric acid and potash.

Usually nitrogen is supplied by one class of materials, phosphoric acid by another, and potash by still another, and complete fertilizers containing nitrogen, phosphoric acid and potash are made by mixing one or more of each of these three classes of materials in such quantities as will give the amounts or per cents of nitrogen, phosphoric acid and potash desired in the mixtures.

It is desirable that the farmer, especially when he mixes any or all of his own fertilizer, should be familiar with the materials furnishing nitrogen, phosphoric acid and potash, and their richness in the constituents sought, together with their special fitness for certain crops and soils, if they possess advantages over each other.

NITROGEN—ITS FORMS AND THE MATERIALS SUPPLYING IT.

Nitrogen is what is known to chemists as an element. It is one of the simplest possible forms of matter. From nitrogen nothing but nitrogen can be obtained, no matter to what treatment it may be subjected. There are something more than seventy of these elementary substances, all different from each other, and which singly and united to each other form plants, animals, earth, air and water. Some of these elements are solid, as iron, gold, silver, etc.; some liquids, as mercury (quicksilver), and some gases. Nitrogen is a gas; it makes up about four-fifths of the air, and from our everyday experience with and in the air we know nitrogen is a substance free to move, and has weight, but is without color, order or taste. It is thus seen that nitrogen is one of the most abundant of substances, and yet it is one of the three soonest exhausted in soils, and is one of the most costly constituents of fertilizers. Nitrogen, as it exists in the air, is not, according to the best evidence we have at present, plant food for such crops as corn, cotton, the small grains, grasses, etc. Before most of our agricultural crops can

use nitrogen it must be gotten in combination with some other element or elements.

WHY PEAS IMPROVE THE SOIL.

It is only the leguminous (pod-bearing) class of plants, such as peas, beans, the clovers, alfalfa, peanut, vetches, etc., that can use this free (elementary) nitrogen as it exists in the air in their growth. On their roots will be found nodules, warts, or tubercles, and in these are large numbers of micro-organisms (minute forms of life, which can only be seen with the aid of the microscope), which have the power to put the free nitrogen of the air into such forms or combinations that these plants decay in or on the soil, the nitrogen which they collected, through the aid of the micro-organisms, from the air is left in such condition that other agricultural plants can use it, and in this is the explanation of the improving and enriching power of a pea or similar crop. The cowpea takes nitrogen from the air, which most plants cannot do, and adds it in the decay of its roots and tops to the supply of combined nitrogen in the soil, while corn, cotton, oats, the grasses, etc., have to depend on the nitrogen already in the soil, or that which is supplied in fertilizers and manure, or added in the leguminous crops. The importance of a full understanding of the foregoing fact and its meaning to improved agriculture cannot be too well understood.

We have thus discussed what is known as the free, uncombined or gaseous nitrogen of the air, the original and greatest of all sources of nitrogen. It can only be used first hand by one class of agricultural plants. The farmer should get all he can of this valuable and costly fertilizer constituent through these plants.

SULPHATE OF AMMONIA AS A SOURCE OF NITROGEN.

For fertilizers nitrogen must be sought in materials which already have it in combination. Nitrogen in combination with another gas element—hydrogen—which is a constituent of water, forms what is known as ammonia, which is itself a gas. It is very soluble in water and the pungent odor of "spirits of hartshorn" or ammonia water, is due to this gas—ammonia. The odor about stables and especially manure piles is due mainly to ammonia gas passing off into the air to be brought down by dew or rain to fertilize some distant field.

This gas—ammonia—has a great fondness for sulphuric acid, with which it unites with vigor, the resulting substance being a white solid, known and familiar to fertilizers dealers and users as sulphate of ammonia. The commercial sulphate of ammonia, as used in fertilizers, contains about twenty per cent of nitrogen, which is equal to about twenty-four per cent of ammonia. A ton of this contains 400 pounds of nitrogen, which is 80 pounds more than is found in a ton of nitrate of soda, the next richest source of nitrogen in fertilizers.

In this material the ammonia is held and prevented from escaping by the sulphuric acid. Sulphate of ammonia is easily soluble in water and distributes itself through the soil where the plant roots can get at it. From it plants can obtain the nitrogen necessary to their growth. It is, on so-

count of the ease with which water dissolves it, one of the most available and quick-acting sources of nitrogen for plants, but is at the same time one of the most, if not the most, costly sources. It has the advantage of not being readily washed out of soils, as clay and humus (decayed vegetable matter) have the power of holding it. The supply is rather limited and it is obtained mainly as a waste product in the manufacture of gas from soft coal, in the production of coke from coal, in the distillation of bones for making bone black, etc.

In sulphate of ammonia the nitrogen is said to be in the form of ammonia.

NITRATE OF SODA

Nitrate of soda is a white solid, which is mined in the rainless districts of South America, especially in Chili and Peru. As found there it is mixed with other substances, but when purified and put on the market as commercial nitrate of soda for use as fertilizer, it contains fifteen and one-half to sixteen per cent of nitrogen, or 320 pounds in a ton. The remaining 1,680 pounds in the ton is made up of the elements sodium and oxygen, to which the nitrogen is united to form the nitrate of soda, and in addition forty to sixty pounds of impurities, mostly common salt.

Nitrate of soda dissolves in water with great ease, and distributes itself through the soil where the plant roots can get at it. It is the form of nitrogen that plants like most and which they take up in the greatest abundance. It is also the quickest acting form of nitrogen, its effect on growing plants being often seen in the increased vigor and greenness of plants in two or three days after the application is made. It may be of interest to state here that scientific workers have shown that nearly all the nitrogen of plants enters them as nitrate. For instance, when sulphate of ammonia is put in the soil the nitrogen in it is changed, by the aid of micro-organisms, from the ammonia form to the nitrate form, and the nitrogen of such materials as cotton-seed meal, when it decays, passes by the help of minute forms of life in the soil to nitrates, when it is taken up by the plant. This high availability (solubility) of nitrates renders it liable to loss by washing out of the soil. It is the form of nitrogen most easily lost in the drain waters of the soil, and humus and clay do not hold it as they do the ammonia of sulphate of ammonia. Plants are so fond of it, however, and take it up with such ease, that very little is ever lost when there is a growing crop on the soil. In this may be seen the advantage of green crops in the fall and winter, especially in wet, warm climates and on loose, sandy and loam soils.

The preceding has had reference to what is known as the nitrate form of nitrogen. Next week we will consider the organic materials containing nitrogen.

B. W. KILGORE.

With this issue The Progressive Farmer enters its nineteenth volume. We make no new promises; the paper will speak for itself. We are glad to say that our circulation is increasing at an almost unprecedented rate, our subscription receipts during January equalling those for the three preceding Januaries combined.